

Draw an indefinite right line divided into a scale of equal parts each representing 1^s . Cut off from the beginning a portion $= c''$; at the point of section erect a perpendicular which make $= c'$, draw from the extremity of this perpendicular a line making an angle $= 90 - \delta$ with it, and also draw a parallel to this line at the distance c from it; the last-drawn line will cut off from the original line a part equal the sum of the corrections. For, as will be easily seen, the intercepted points by the two parallel lines are respectively the cotangent and cosecant of δ to the respective radii c' and c .

The foregoing construction is very ingeniously reduced to practice by Mr. Carrington, but it would not be easy to make the matter intelligible without drawings.

Any person who is interested in the subject may inspect the instrument, and Mr. Carrington's explanation of its use, at the Society's apartments. Mr. Carrington "believes that the instrument will work to two places of decimals for all stars not less than 5° distant from the pole, and that a mistake in sign, or in the place of the decimal points, is rendered impossible." Mr. Carrington adds, "I allude to Professor Challis's instrument merely to recall the fact that his preceded mine."

Note on correcting Series of Transit Observations for Instrumental Error. By Mr. Sheepshanks.

The mechanical contrivances of Professor Challis and Mr. Carrington for this purpose, induce me to mention a method which, under certain circumstances, I found very convenient for freeing transit observations from instrumental error. Starting from the well-known formula, that the sum of corrections may be represented by $m + n \tan \text{Dec} + c \sec \text{Dec}$ (m and n are, with me, unknown quantities, to be determined from the observations themselves, c the unknown correction for collimation), I observed a large number of stars on one night, and the same stars on a following night, *with the instrument reversed*. Then, since the collimation changes its sign, and the new values of m and n have the same factors as before, the observed place of the star deduced from a *mean* of the two nights, required a correction of $m' + n' \tan \text{Dec}$, the collimation being eliminated. If the rate of the clock was considerable, the observations were corrected for rate before taking the means. I then selected the Greenwich stars near the pole, *Polaris* or δ *Ursæ Minoris* if possible, and the Greenwich stars near the equinoctial, and from these two groups obtained the value of m' and n' , which were generally found with extreme accuracy. All the unknown stars were then corrected by applying $m' + n' \tan \text{Dec}$ to their mean results from the two nights' observations.

To facilitate the computation, I had cards printed of the natural tangents and secants of declination to 90° . (These may be procured at the Society's apartments.) The advantages are that in *cataloguing* you save the trouble of determining the level

azimuth and collimation errors, and if your instrument be faultless, and the Greenwich catalogue perfect, have no error left except the mere error of observation, which, when fourteen wires are noted, is very trifling. There is only one reduction to the mean place for two observations. Some observations of my own, and some made by Mr. Hartnup at my request, lead me to think that in two fine nights, a catalogue of quick moving stars may be formed, in which an error of $0^s.05$ would be somewhat unusual.

On the Weights to be given to the separate Results, and to the final Result, for Terrestrial Longitudes determined by the Observations of Transits of the Moon and Fixed Stars. By the Astronomer Royal.

This paper contains the investigations for the principal cases which occur in practice. The *weight* of any one observation is taken as the reciprocal of the square of the probable error in seconds of time. The combination-weight of an observation is the number by which it is to be multiplied, in combining it with the results of other observations.

Case 1. The transits of the moon and one star, on a single evening, are compared with the places in the *Nautical Almanac*, considered as perfectly accurate: to find the weight and probable error of the result.

To find the weight of the result;—Form the fraction whose numerator is the product, and whose denominator is the sum, of the weights of the moon-observation and the star-observation, multiply this fraction by $\left(\frac{1}{3600}\right)^2$: the product is the weight of the result.

Case 2. Transits of the moon and several stars, observed in one evening, are compared with the places in the *Nautical Almanac*, supposed accurate.

The combination-weights for the several results will be the weights of the star-observations, without respect to the observation of the moon.

To obtain the weight of the final result;—Form the fraction whose numerator is the product of the weight of the moon-observation by the sum of the weights of the star-observations, and whose denominator is the sum of the weights of the moon-observation and the star-observation; multiply this fraction by $\left(\frac{1}{3600}\right)^2$: the product is the weight of the final result.

It will easily be seen, from this rule, that very little is gained by increasing the number of *stars* observed on the same night.

Case 3. Transits of the moon and several stars are observed at the primary station, and transits of the moon and several stars (it matters not whether the number of stars is the same, or whether